Avian Migratory Flight & Oxidative Stress: The Impact of Exercise on Erythrocytic Antioxidant Defense Systems

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Migratory Flight & Oxidative Stress

The Impact of Exercise on Erythrocytic Antioxidant Defense Systems
Overview

• Oxidative Damage
• Dietary Impact
• Migratory Flight
• Antioxidant Defense Systems
• Experimental Design
• Results
Oxidative Damage

Antioxidants critical
  Neutralize oxidants

Aerobic respiration
  Efficient energy production mechanism
  Creation of ROS (Hulbert et al. 2007)

Reactive Oxygen Species (ROS)
  Lead to damaged proteins, lipids & DNA in high amounts (Hulbert et al. 2007)
Oxidative Damage In Aging

Linked to age-related disease
Alzheimer’s, Parkinson’s & Huntington’s (Cui et al. 2011)

Research supports development of preventative medicine and treatment options
Migratory Birds
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- Model organisms
  - Lifestyle promotes oxidative stress

- Endurance athletes
  - Migration not comparable to human physiological challenge (Guglielmo 2010)

- Increased physical demand requires increased metabolic activity

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Primarily fatty acid oxidizers (Pierce et al., 2005)
- 90% energy from fat (Guglielmo 2010)

Birds alter diet to alter fatty acid composition
- Prefer unsaturated fatty acids to saturated (Price 2010)
- n-6 PUFA diets → enhanced exercise performance (Pierce et al. 2005)

PUFAs increase oxidative damage (Jenkinsson et al. 1999)
Endogenous Antioxidants

- Erythrocytes regularly exposed and highly susceptible to oxidative damage (Pandey & Rizvi 2011)
- Equipped with cytoplasmic defense systems
  - Endogenous antioxidants
- Focus on GPx
Basic Experimental Design

Western Ontario University

Divide subjects into 4 distinct dietary groups
- Vary in antioxidant content and in PUFA content

Simulate migration through flight training in wind tunnel

Collect blood samples

Assay samples to determine antioxidant concentration

Available from: http://birds.uwo.ca/
Predictions

Exposure & reaction to oxidative stress
- Vary based on dietary group & exercise

GPx concentrations
- Higher in increased PUFA diet
- Lower in high antioxidant diet
- Higher following physiological challenge
Study Species

- European Starling (*Sturnus vulgaris*)
  - Can travel 1,000-1,500km
  - 60-80km/h (Linz et al. 2007)

- 100 birds total, 25 in each dietary group
Diet Conditions

Imitates natural diet
- 41% carb: 13% protein: 30% fat
- 16:0, 18:1, 18:2
- Anthocyanins

4 diet groups
- 13% PUFA Low Antioxidant
- 13% PUFA High Antioxidant
- 32% PUFA Low Antioxidant
- 32% PUFA High Antioxidant

Allowed 1 month to acclimate
Flight Training

- 15 birds from each diet trained
  - 10 serving as controls

- 5 flight cohorts in each diet → 20 total
  - 3 birds flown together

- Pre-training period

- 15-day flight period
  - Gradual increase of flight time
  - Leads into “long flight”

- EchoMRI
  - Before & after long flight
The EchoMRI showed that the flight was a clear, physiological challenge.
Sample Collection & Processing

- Samples taken before & after longest flight (pre-flight & after-flight)
- Collection with heparinized tube
  - Erythrocytes separated from plasma
  - Frozen at -80°C
- Analysis of GPx with Cayman kit
Results

- Increase in GPx among all diet groups
- Most dramatic increase in high antioxidant groups
- PUFAs had little perceived impact
  - Unexpected
- Possible interaction?
- Sample size
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References


Pandey K, Rizvi S. 2011. Biomarkers of oxidative stress in red blood cells. Biomedical papers of the Medical Facility of the University Palacky, Olomouc Czechoslovakia. 155(2) 131-136.

